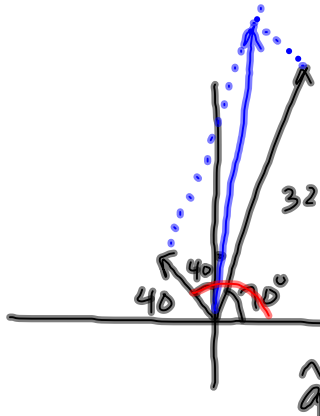
25.

20° E of N 325 mph 40 W of N 40 mph



$\hat{a} = \langle 325\cos 70°, 325\sin 70° \rangle$

$\hat{w} = \langle 40\cos 130°, 40\sin 130° \rangle$

$+$

$\hat{g} = \hat{a} + \hat{w} = \langle \quad \rangle$

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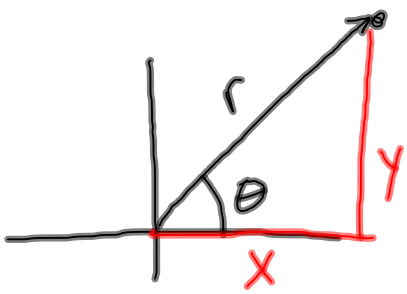
10.3 Polar coordinates, Polar graphs



(r, θ)

(x, y)

$x = r\cos\theta$

$y = r\sin\theta$

$r = \sqrt{x^2 + y^2}$

convert to polar

$(-3, 4) \rightarrow r = 5$

$\theta = 126.87°$

2.2143

$\theta = \tan^{-1}\left(\frac{y}{x}\right)$

if (x, y) in QII or QIII add π $(180°)$

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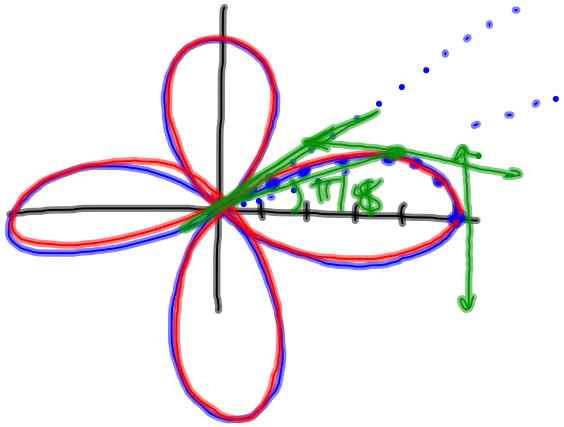
Polar functions $r = f(\theta)$

$r = 5\cos(2\theta)$

θ	r
0	5
$\frac{\pi}{4}$	0
$\frac{\pi}{8}$	$5\frac{\sqrt{2}}{2} \approx 3.53$
$\vdots$	$\vdots$



4-leafed rose

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$$\text{slope} = \frac{dy}{dx} = \frac{\frac{dy}{d\theta}}{\frac{dx}{d\theta}}$$

$r = f(\theta)$

$x = r\cos\theta = f(\theta)\cos\theta$

$y = r\sin\theta = f(\theta)\sin\theta$

$r = 5\cos(2\theta)$

$x = 5\cos(2\theta)\cos\theta$

$y = 5\cos(2\theta)\sin\theta$

$$\frac{dy}{dx} = \frac{5\cos(2\theta)\cdot\cos\theta + \sin\theta(-10\sin(2\theta))}{5\cos(2\theta)(-\sin\theta) + \cos\theta(-10\sin 2\theta)}$$

$$\left.\frac{dy}{dx}\right|_{\theta=0} = \frac{5+0}{0+0} = \infty$$

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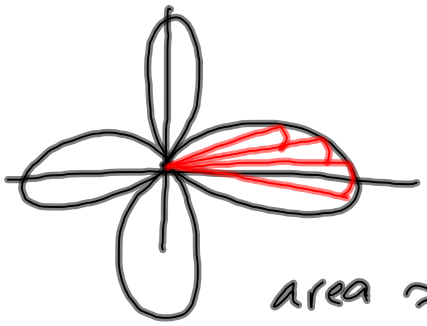
area inside a polar graph



area $\Delta A = \frac{1}{2} r^2 \Delta\theta$

area $\approx \sum \frac{1}{2} r_i^2 \Delta\theta$

$$\text{area} = \int_{\theta_1}^{\theta_2} \frac{1}{2} r^2 \, d\theta$$

need r as a function of θ

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Find the area inside 1 leaf of $r = 5\cos(2\theta)$

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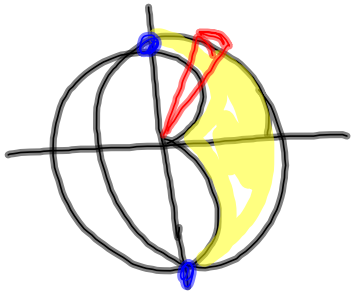
area between 2 polar curves.

Find the area inside the circle $r = 1$ and outside the cardioid $r = 1 - \cos\theta$



$$\int_{\theta_1}^{\theta_2} \frac{1}{2} R^2 - \frac{1}{2} r^2 \, d\theta$$

$$\int_{-\pi/2}^{\pi/2} \frac{1}{2} \cdot 1^2 - \frac{1}{2} (1-\cos\theta)^2 \, d\theta$$

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